Hybrid Power

Hybrid System Development at Eaton Corporation

Eaton: A Proven Leader in Commercial Hybrid Vehicles

- Eaton is the only hybrid system supplier developing both hybrid electric and hybrid hydraulic solutions.

- This puts Eaton in the unique position of being able to offer our customers the best possible solution, not just the one we have.

HEV and HHV Comparison

- The value proposition for any hybrid is dependent on the vehicle's duty cycle.
- Hybrid electric systems have much higher energy storage capacity, and generally have low to moderate power capabilities.
- In addition, hybrid electric systems can more easily provide an auxiliary electric power source from the vehicle.

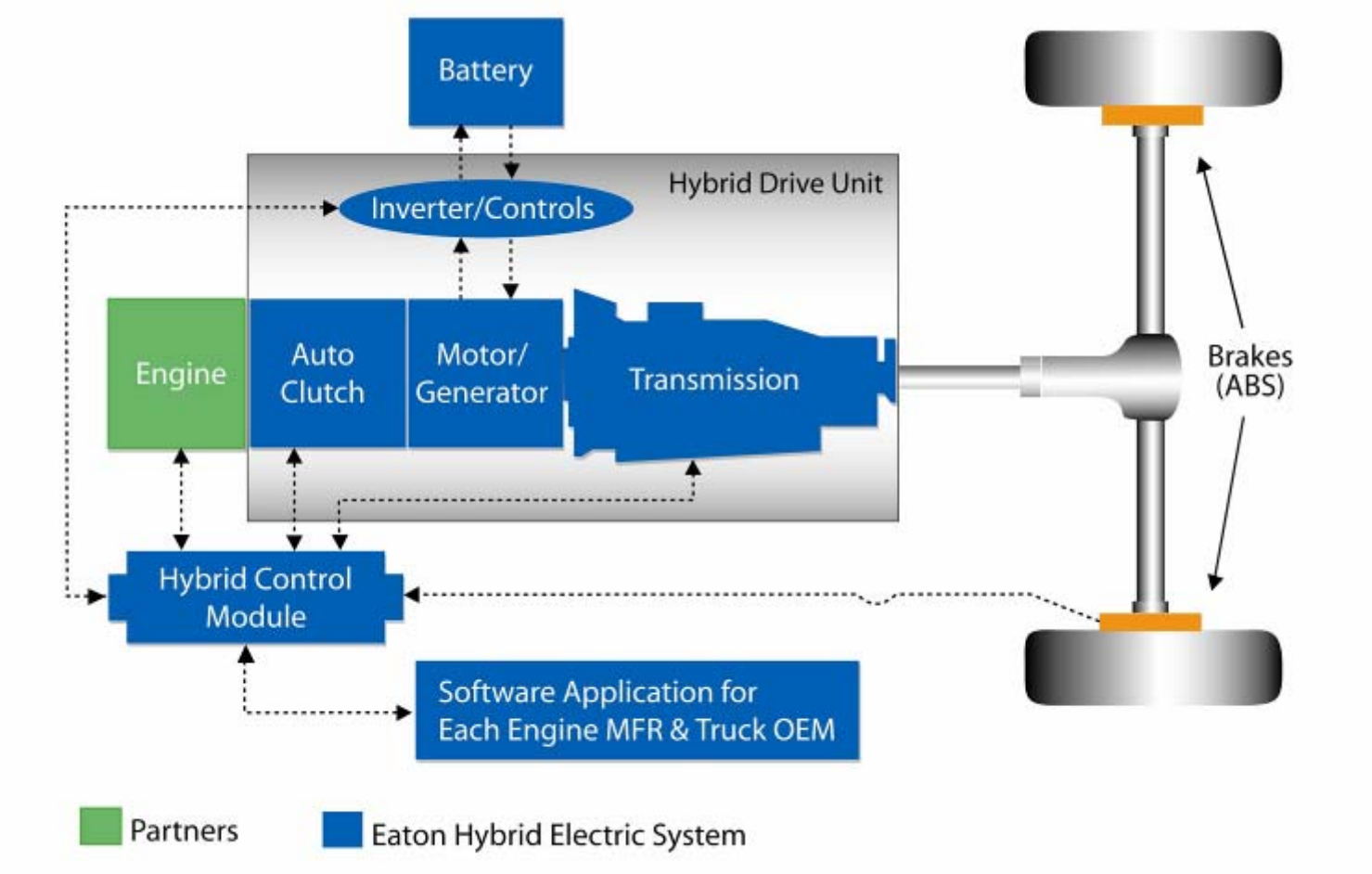
HEV and HHV Comparison

- Hybrid hydraulic systems have much higher power capabilities, for a shorter length of time.
- In addition, they typically regenerate more braking energy than hybrid electric systems.

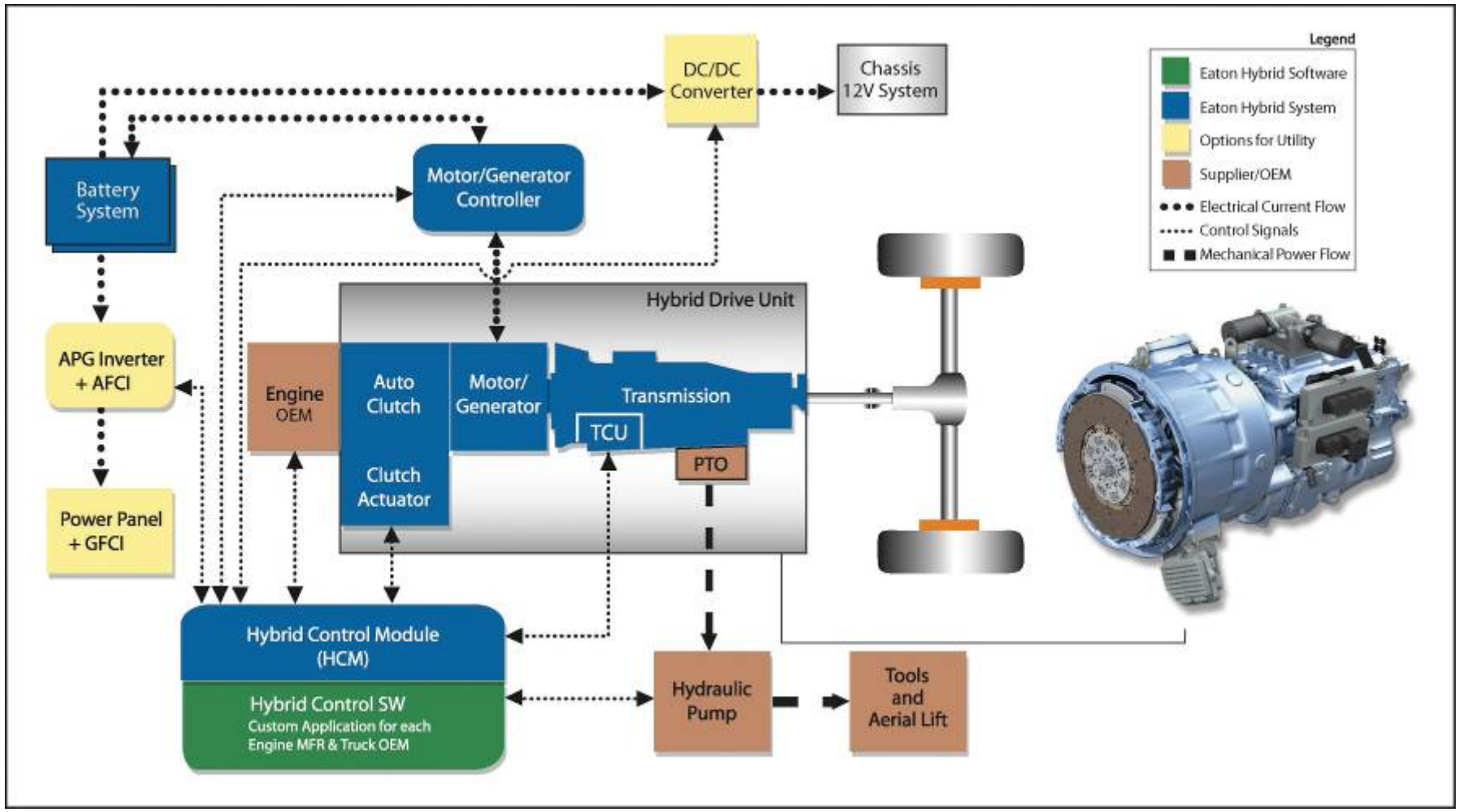
HEV and HHV Comparison

- Eaton has studied both technologies in a wide variety of applications.
- We believe that there are significant opportunities for both technologies.
- In some cases the choice of technology is clear, in others it is less so.
- The market is still evaluating both technologies in many cases.

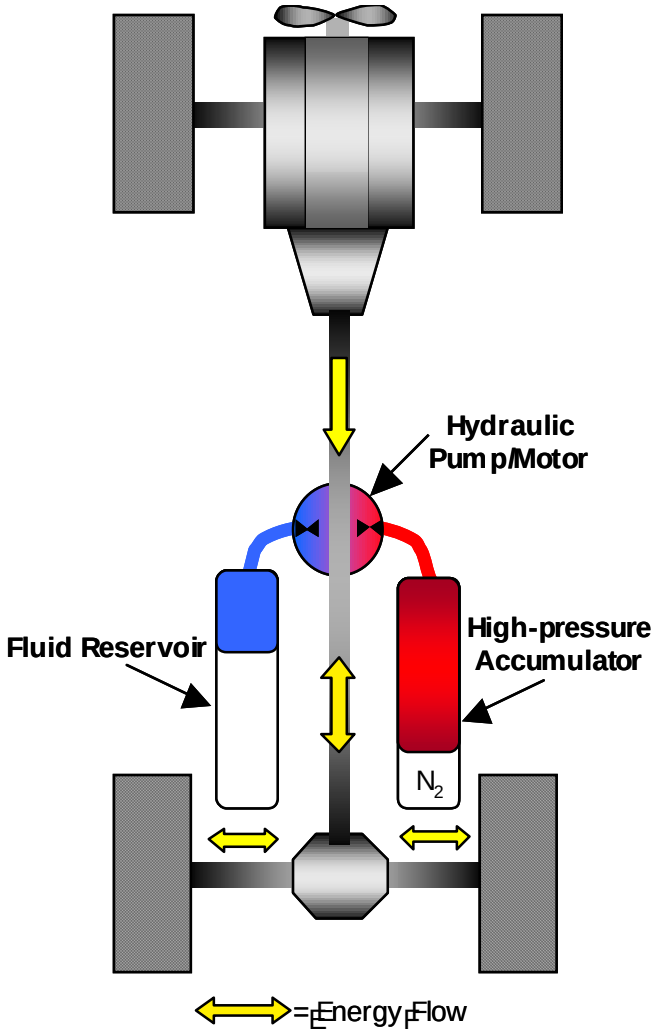
City Delivery HEV System Diagram



Utility HEV System Diagram



Parallel Hydraulic Hybrid Architecture



Eaton HLA® System

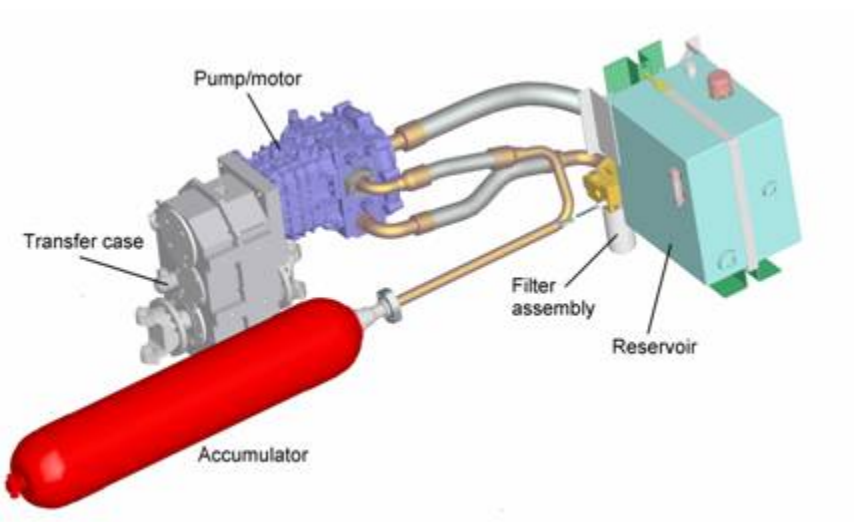
- In a parallel hydraulic hybrid, the conventional vehicle driveline is *supplemented* by the addition of the hybrid system.
- The system is best suited for vehicles that operate in stop and go duty cycles. Examples include refuse trucks and buses.
- The value proposition is provided by:
  - Improved fuel economy achieved through regeneration of braking energy
  - Lower maintenance costs. Brake life is increased 2-4 times.
  - Improved productivity (e.g., more refuse pickups per day) due to the extra power the HLA system provides.
- Fuel economy and emissions improvements of 20-30% and payback periods of 3 years or less are possible in vehicles making frequent stops.

HLA System for Light & Medium Duty

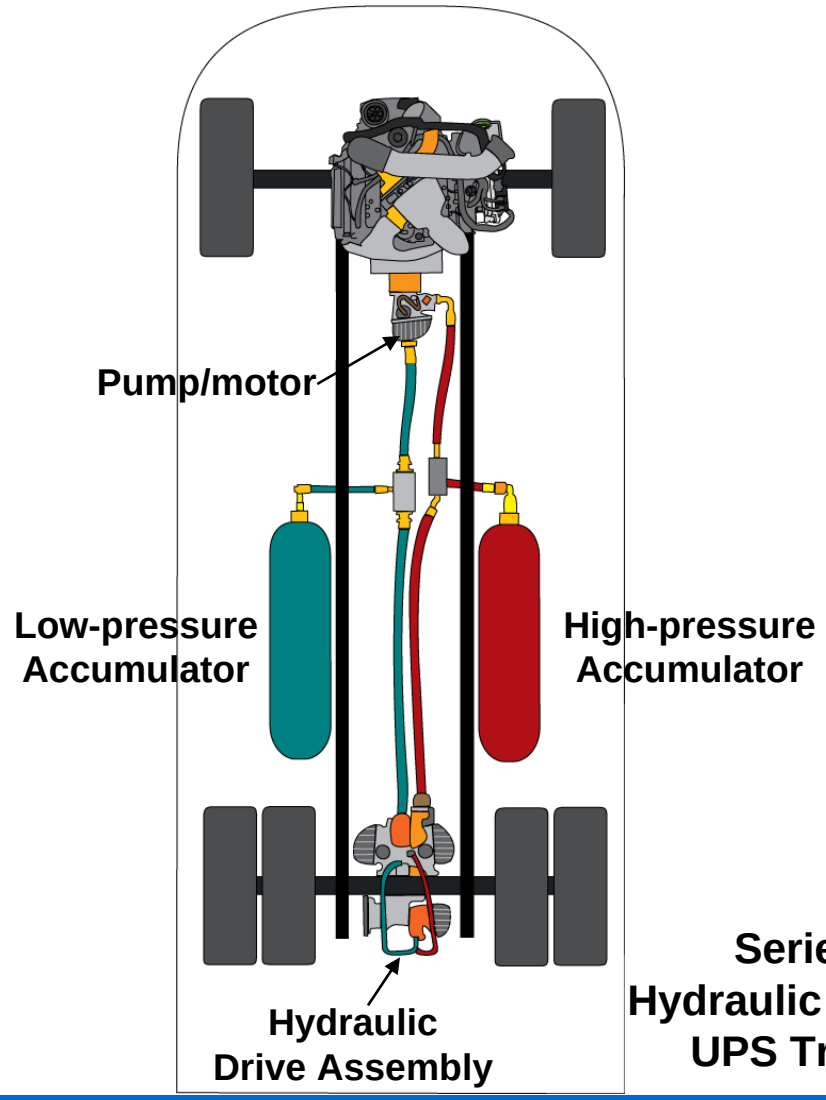
- A diesel hydraulic hybrid shuttle bus on a Ford E-450 chassis was delivered to the US Army in May 2006.
- The vehicle met or exceeded all of the program goals including demonstrating >25% fuel economy improvement on the EPA city driving cycle and reducing in-cab noise during acceleration by more than 6 dBA.
- Eaton is continuing its work applying the HLA system to light & medium duty commercial vehicles.

HLA System for Heavy Duty

- Eaton began delivering a fleet of refuse trucks with pre-production HLA systems to end users in December 2007. These vehicles will be used in refuse collection service for approximately one year.
- Eaton plans to release the HLA system for use in Peterbilt 320 refuse chassis in 2008.



Series Hydraulic Hybrid Architecture



Series Hydraulic Hybrid UPS Truck

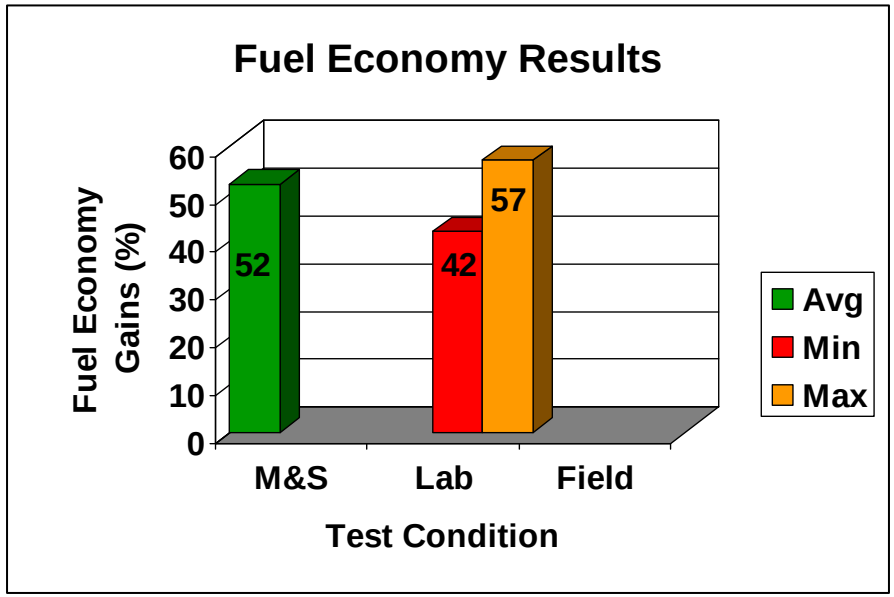
- In a series hydraulic hybrid, the driveline is *replaced* by the hybrid system. The transmission is removed and energy is transferred from the engine to the drive wheels through fluid power.
- The technology is suited to a broader range of applications than parallel hydraulic hybrids, though benefits are still greatest in stop and go duty cycles.
- The value proposition is provided by:
  - operating the engine at a “sweet spot” of best fuel consumption facilitated by the CVT functionality of the hybrid system
  - regeneration of braking energy
  - shutting the engine off when not needed
- Fuel economy improvements with this technology are significantly higher than those attainable by the HLA system.
- This technology is in the prototype stage.

Series Hybrid Hydraulic Drivetrain

- The **US EPA, Eaton, UPS, International Truck and Engine**, and the **US Army** partnered to build the world's first hydraulic hybrid parcel delivery truck. This vehicle was first shown publicly in June 2006.
- The series hybrid hydraulic UPS truck demonstrated 50-70% better fuel economy than a standard UPS truck over the EPA City Cycle with no degradation in performance.
- A UPS truck equipped with the series hybrid hydraulic drivetrain was placed in service in the Detroit area and achieved 45-50% better fuel economy in "real world" use.

Eaton Hybrid Electric FedEx Program Status

- 93 trucks at 20 stations (US & Canada)
- 45 production trucks delivered in May 2008
- In-Service Date:
  - FedEx 18 – February 2004 (initial units)
  - FedEx 75 – October 2006
- Mileage & Availability:
  - FedEx 18: 760K miles @ Cum 98% (100% in January 2008)
  - FedEx 75: 1.2M miles @ Cum 95% (96% in January 2008)



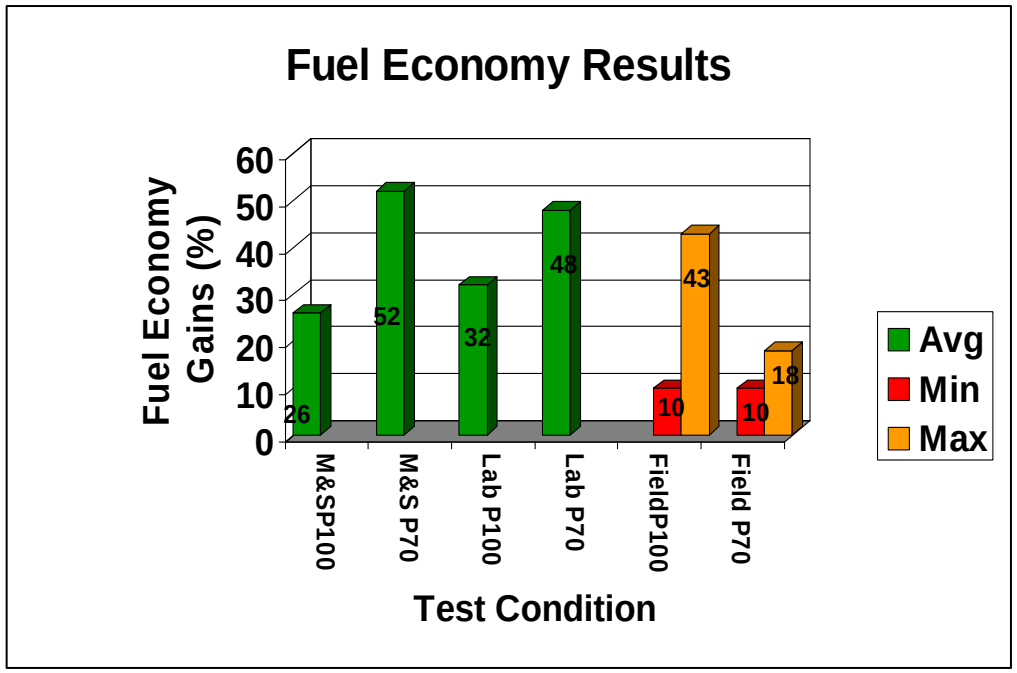
- Typical Driving Cycle - City Delivery
- Baseline Engine: Cummins ISB, 6 cyl, 5.9L 175 HP (AT)
- Hybrid Engine: MBE-904, 4 cyl, 4.3L, 170 HP (AMT)

IRS Tax Credit APPROVED

Lab Test: Southwest Research Institute; SwRI

Eaton Hybrid Electric UPS Program Status

- 50 trucks at 4 stations in US
  - In-Service Date: April 2007
  - 501k miles @ 96% availability
- 200 trucks ordered in June 2008



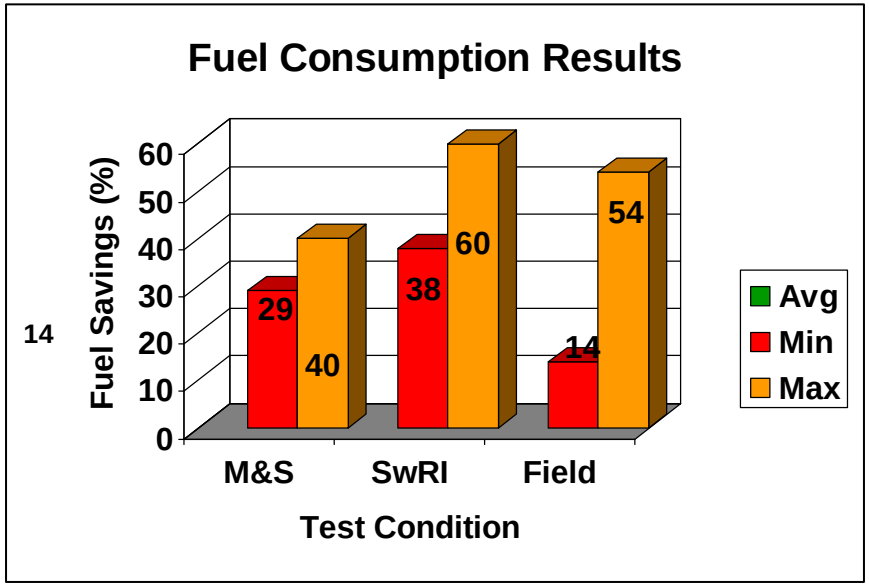
- Typical Driving Cycle - City Delivery
- Baseline Engines:
  - P100: ITEC VT365 V8 200 HP (AT/MT)
  - P70: Cummins ISB I6 185 HP (AT/MT)
- Hybrid Engine:
  - P100: ITEC VT275 V6 180HP (AMT)
  - P70: MB904 I4 170HP (AMT)

IRS Tax Credit APPROVED

Lab Test: Independent Research Facility – NREL
Field Test: UPS - NREL Controlled Tests Planned

Eaton Hybrid Electric HTUF Program Status

- 24 Vehicles, 14 Fleets (US and Canada)
- In Service Date:
  - May 2006, 18 Month Field Trial
- Mileage & Availability
  - 480k miles @ 99%



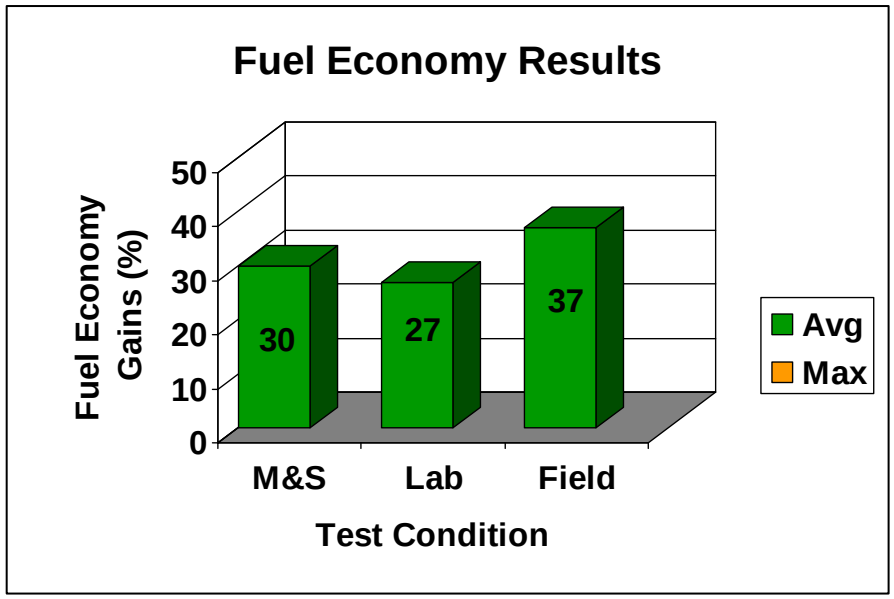
- Typical Driving Cycle: CILCC Job Site: Varied Hydraulic Duty Cycle (**3-6** Hrs. M&S and Lab; **0-3** Hrs. Field Test)
- Field Test/Lab/M&S Baseline and Hybrid Engine: DT466, 6 cylinder, 7.6L, 225 HP

IRS Tax Credit APPROVED

Lab Test: Southwest Research Institute

Eaton Hybrid Electric Coke Program Status

- 4 Trucks (Kalamazoo, Phoenix, Bronx)
- In-Service Dates:
  - First Field Trial: 2004 – 2006
  - Production Field Placements ’07-’08
- 120 unit order placed for 2008 delivery



- Typical Driving Cycle - City Delivery
- Hybrid Engine:

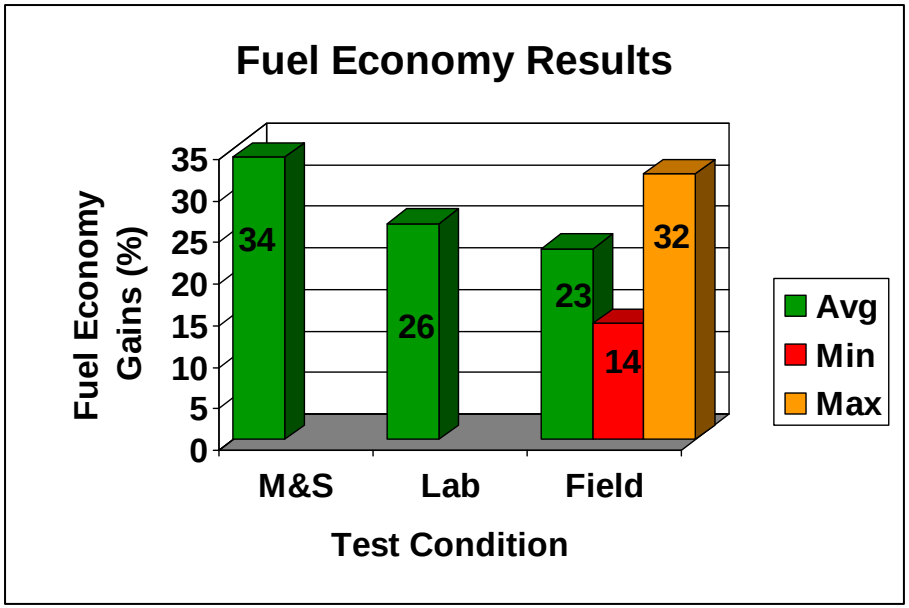
  MaxxForce DT, I6 7.6L 225HP

IRS Tax Credit APPROVED

Lab Test: Southwest Research Institute; SwRI
Field Test: Coke Operating Data

Eaton Hybrid Electric Frito-Lay Program Status

- 1 Truck in Fort Worth, TX
- In-Service Date: January 2007
- Mileage & Availability
  - 5733 miles @ 100% availability

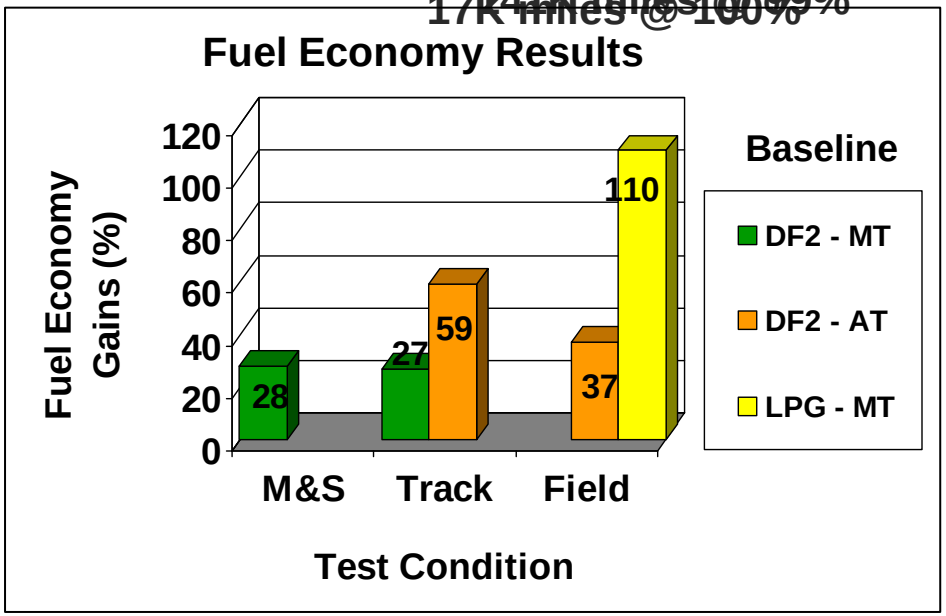


- Typical Driving Cycle: City Delivery
- Baseline Engine:
  - GM 6.5 L V8 160HP, AT
- Hybrid Engine:
  - ITEC VT275 4.5L V6 DI, Turbo, 180HP, AMT

Lab Test: Source – SwRI
Field FE Test: Source – Lopez Garcia Group

Eaton Hybrid Electric
Foton Bus Program Status

- 31 buses in Guangzhou, China
- In-Service Date:
  - Prototype 1: January 11, 2008
  - Production 6: April 2007
- Mileage & Availability:
  - Prototype 1: 141K miles @ 99%
  - Production 30: 17K miles @ 100%



- **Typical Driving Cycle:**
  New Chinese Bus Cycle
- **Baseline Engine:**
  Various makers, typically 6-Cyl, 220 – 260 HP, Euro 2-3
- **Hybrid Engine:**
  ISBe 6-Cyl, 185 – 220 HP, Euro 3

Track Test: China Chongqing Bus Test Center
Field Test: Guangzhou Yiqi Bus Company

MT–Manual Trans; AT–Automatic Trans

Eaton Hybrid Hydraulic HLA® System Program Status

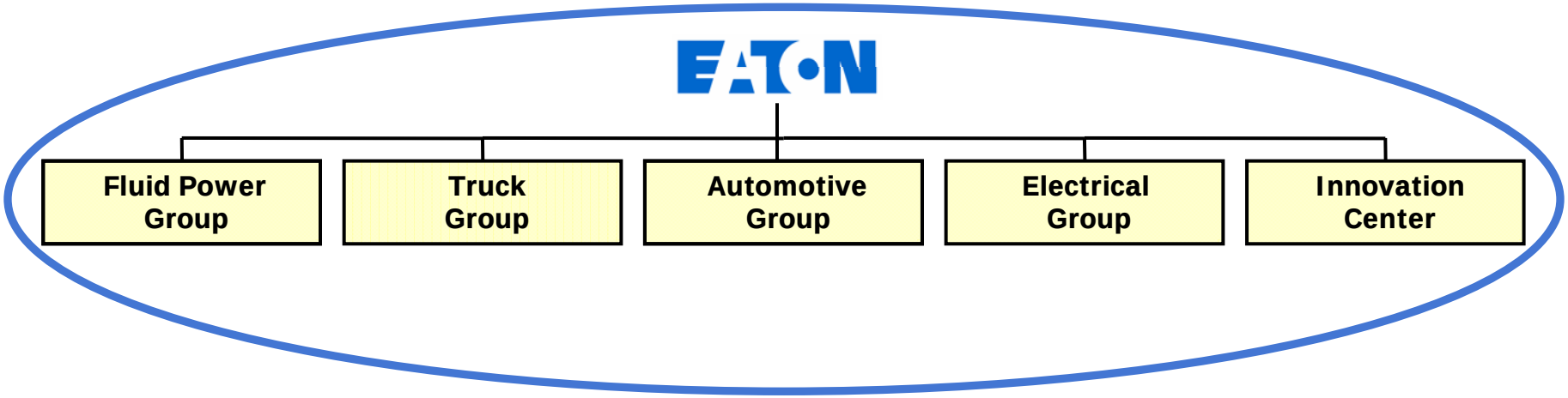
- 12 refuse trucks with pre-production HLA systems currently being deployed
- These vehicles will be in real world service for one year
- First trucks are in service; balance will be in service this summer
- Initial “real world” fuel economy very promising
- Production launch scheduled for December 2008

- Peterbilt Model 320 chassis
  - 330 hp engine
  - 60,000 lb GVW
- Typical Driving Cycle
  - 600-1200 refuse pickups in a 10 hour shift
- 15-30% improvement in fuel economy

In Summary

- Eaton has made a substantial commitment to develop technologies that will simultaneously reduce energy consumption and exhaust emissions.
- Eaton is developing a portfolio of hybrid electric and hybrid hydraulic products that will provide solutions in a wide variety of on- and off-highway vehicles.
- Eaton is currently offering hybrid electric products for commercial vehicle applications and our hydraulic hybrid products will enter the market in 2008.

The Power of One Eaton



Eaton is globally positioned with world-class engineering expertise and manufacturing capabilities in the Fluid Power, Truck, Automotive, and Electrical markets.

Eaton Corporation
2007 Sales $13.0B
70,000 employees
Sells products in more than 140 countries worldwide

Eaton is proud to be the recipient of the 2008 CALSTART Blue Sky™ Award for Environmental Innovation in Sustainable Transportation Technology